

WHAT IS CLAIMED IS:

1. A neurological stimulation system adapted for implantation into a person's body for electrical stimulation of target nerve tissue in the person's brain stem, comprising:

5 an electrical stimulation lead adapted for implantation on, in, or near the brain stem for electrical stimulation of target nerve tissue in the brain stem, the lead comprising a plurality of electrodes adapted to be positioned on, in, or near the target nerve tissue in the brain stem and to deliver electrical stimulation energy to the target nerve tissue in the brain stem; and

10 a stimulation source adapted for implantation in the person's body and operable to generate signals for transmission to the electrodes of the lead to cause the electrodes to deliver electrical stimulation energy to the target nerve tissue in the brain stem.

15 2. The system of Claim 1, wherein the target nerve tissue in the brain stem is selected from a group consisting of nucleus solitarius, medulla oblongata, olivary nuclei, cerebellar tracts, inferior cerebellar peduncle, extrapyramidal system, trigeminal nucleus, nucleus gracilis, nucleus cuneatus, arcuate fibers, vagal nuclei, medial lemniscus, nucleus ambiguus, trigeminal nerves, spinothalamic tracts and  
20 vagus nerve.

3. The system of Claim 1, wherein the target nerve tissue in the brain stem affects the treatment of at least one condition selected from a group consisting of acute pain, chronic pain, headache, migraine headache, cluster headache, sinus  
25 headache, occipital headache, occipital neuralgia, trigeminal neuralgia, atypical facial pain, pseudotumor cerebri, nausea, depression, cardiac respiratory disorders, relex sympathetic dystrophy, causalgia, peripheral nerve pain, regional pain syndromes, ataxia, Parkinson's disease, movement disorders, tremors, akinesia, rigidity, dyskinesia, bladder dysfunction, detrusor dyssynergia, plexopathies, incontinence,  
30 interstitial cystitis, seizures, radiculopathy, diabetic neuropathy, Raynaud's disease, Raynaud's syndrome, Wegener's disease, cancer, sexual dysfunction, paraplegia, pelvic floor dysfunction, angina, obesity, anorexia and spasticity.

4. The system of Claim 1, further comprising a removable stylet configured to be inserted into an inner channel of the electrical stimulation lead and further configured to maintain the lead in a straightened position during insertion of the lead into position on, in, or near the target nerve tissue in the brain stem.

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5. The system of Claim 4, wherein the electrical stimulation lead is configured to expand into a surrounding space in or near the brain stem when the stylet is removed from the inner channel of the lead.

10 6. The system of Claim 1, wherein the electrical stimulation lead is configured in one of the following shapes:

- a line;
- a two-dimensional spiral;
- a three-dimensional spiral;
- 15 a square;
- a circle;
- a pigtail;
- a hockey stick;
- a mirror image hockey stick;
- 20 a Y-shape; and
- a T-shape.

7. The system of Claim 1, wherein the electrical stimulation lead comprises a substantially two-dimensional matrix lead incorporating an array of  
25 electrodes spaced about a substantially planar surface of the lead.

8. The system of Claim 1, wherein the electrical stimulation lead is configured to stimulate symmetrical targeted areas in both sides of the brain stem simultaneously.

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9. The system of Claim 1, wherein the electrical stimulation lead comprises a catheter having at least one opening configured for delivering medication to the target nerve tissue.

5 10. The system of Claim 9, wherein the medication comprises one or more of a local anesthetic, a narcotic, analgesics, general anesthetics, chemotherapeutic agents, steroids, gene therapies, neurolytic solutions, radio-pharmaceutical agents and a centrally-active pharmaceutical agent.

10 11. A method for neurological stimulation of target nerve tissue in a person's brain stem, comprising:

implanting an electrical stimulation lead on, in, or near the brain stem, the lead comprising a plurality of electrodes adapted to be positioned on, in, or near the target nerve tissue in the brain stem and to deliver electrical stimulation energy to the target  
15 nerve tissue in the brain stem; and;

implanting a stimulation source in the person's body, the stimulation source operable to generate signals for transmission to the electrodes of the lead to cause the electrodes to deliver electrical stimulation energy to the target nerve tissue on, in, or near the brain stem; and

20 in response to the signals transmitted from the stimulation source, using the electrodes of the lead implanted on, in, or near the brain stem to deliver electrical stimulation energy to the target nerve tissue in the brain stem.

12. The method of Claim 11, wherein the target nerve tissue in the brain  
25 stem is selected from a group consisting of nucleus solitarius, medulla oblongata, olivary nuclei, cerebellar tracts, inferior cerebellar peduncle, extrapyramidal system, trigeminal nucleus, nucleus gracilis, nucleus cuneatus, arcuate fibers, vagal nuclei, medial lemniscus, nucleus ambiguus, trigeminal nerves, spinothalamic tracts and vagus nerve.

13. The method of Claim 11, wherein the target nerve tissue in the brain stem affects the treatment of at least one condition selected from a group consisting of acute pain, chronic pain, headache, migraine headache, cluster headache, sinus headache, occipital headache, occipital neuralgia, trigeminal neuralgia, atypical  
5 facial pain, pseudotumor cerebri, nausea, depression, cardiac respiratory disorders, relex sympathetic dystrophy, causalgia, peripheral nerve pain, regional pain syndromes, ataxia, Parkinson's disease, movement disorders, tremors, akinesia, rigidity, dyskinesia, bladder dysfunction, detrusor dyssynergia, plexopathies, incontinence, interstitial cystitis, seizures, radiculopathy, diabetic neuropathy,  
10 Raynaud's disease, Raynaud's syndrome, Wegener's disease, cancer, sexual dysfunction, paraplegia, pelvic floor dysfunction, angina, obesity, anorexia and spasticity.

14. The method of Claim 11, further comprising inserting a removable  
15 stylet into an inner channel of the electrical stimulation lead and using the removable stylet to maintain the lead in a straightened position during insertion of the lead into position on, in, or near the target nerve tissue in the brain stem.

15. The method of Claim 14, further comprising allowing the electrical  
20 stimulation lead to expand into a surrounding space in or near the brain stem when the stylet is removed from the inner channel of the lead.

16. The method of Claim 11, wherein the electrical stimulation lead is configured in one of the following shapes:

- a line;
- a two-dimensional spiral;
- 5 a three-dimensional spiral;
- a square;
- a circle;
- a pigtail;
- a hockey stick;
- 10 a mirror image hockey stick;
- a Y-shape; and
- a T-shape.

17. The method of Claim 11, wherein the electrical stimulation lead  
15 comprises a substantially two-dimensional matrix lead incorporating an array of electrodes spaced about a substantially planar surface of the lead.

18. The method of Claim 11, wherein the electrical stimulation lead is  
20 configured to stimulate symmetrical targeted areas in both sides of the brain stem simultaneously.

19. The method of Claim 11, wherein the electrical stimulation lead  
comprises a catheter having at least one opening configured for delivering medication  
to the target nerve tissue.

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20. The method of Claim 19, wherein the medication comprises one or more of a local anesthetic, a narcotic, analgesics, general anesthetics, chemotherapeutic agents, steroids, gene therapies, neurolytic solutions, radio-pharmaceutical agents and a centrally-active pharmaceutical agent.

21. A method of implanting an electrical stimulation lead on, in, or near target nerve tissue in a person's brain stem, comprising:

selecting an electrical stimulation lead adapted for implantation on, in, or near the brain stem for electrical stimulation of target nerve tissue in the brain stem, the  
5 lead comprising a plurality of electrodes adapted to be positioned on, in, or near the target nerve tissue in the brain stem and to deliver electrical stimulation energy to the target nerve tissue in the brain stem, the lead comprising an inner channel configured to accommodate a removable stylet;

inserting a needle into the person's epidural space at a desired vertebral level;  
10 inserting a guide wire through the needle and into the epidural space;  
removing the needle from the epidural space, leaving the guide wire in position;

inserting an introducer over the guide wire and into the epidural space;  
positioning the introducer posteriorly in a desired location within the epidural  
15 space at the level of the foramen magnum;

removing the guide wire from the epidural space, leaving the introducer in position;

inserting the electrical stimulation lead including the removable stylet through the introducer and into the epidural space overlying the medulla;

20 positioning the electrical stimulation lead on, in, or near the targeted nerve tissue in the brain stem; and

removing the stylet from the electrical stimulation lead, leaving the lead in position on, in, or near the target nerve tissue in the brain stem for electrical stimulation of the target nerve tissue in the brain stem.

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22. The method of Claim 21, wherein the electrical stimulation lead selected is adapted for a specific location in the brain stem.

23. The method of Claim 21, wherein the electrical stimulation lead is  
30 positioned using stereotactic imaging.

24. The method of Claim 21, wherein the electrical stimulation lead is positioned using a navigation system.

25. The method of Claim 21, wherein the electrical stimulation lead is  
5 anchored at a specific location on, in, or near the brain stem.

26. The method of Claim 25, wherein the electrical stimulation lead is anchored using one or more of sutures, biocompatible glue, adhesive strips and mechanical tethers.

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27. A method for electrical stimulation of target nerve tissue in a person's brain stem, comprising:

selecting an electrical stimulation lead adapted for implantation on, in, or near the brain stem for electrical stimulation of target nerve tissue in the brain stem, the  
15 lead comprising a plurality of electrodes adapted to be positioned on, in, or near the target nerve tissue in the brain stem and to deliver electrical stimulation energy to the target nerve tissue in the brain stem;

creating an opening in the person's skull;  
inserting the electrical stimulation lead through the opening in the skull; and  
20 positioning the electrical stimulation lead on, in, or near the target nerve tissue in the brain stem.

28. The method of Claim 27, wherein the opening in the skull comprises one of:

25 an open craniotomy; and  
a burr hole.

29. The method of Claim 27, wherein the electrical stimulation lead selected is adapted for a specific location in the brain stem.

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30. The method of Claim 27, wherein the electrical stimulation lead is positioned using stereotactic imaging.

31. The method of Claim 27, wherein the electrical stimulation lead is positioned using a navigation system.

32. The method of Claim 27, wherein the electrical stimulation lead is  
5 anchored at a specific location on, in, or near the brain stem.

33. The method of Claim 32, wherein the electrical stimulation lead is anchored using one or more of sutures, biocompatible glue, adhesive strips and mechanical tethers.  
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34. A neurological stimulation system adapted for implantation into a person's body for chemical stimulation of target nerve tissue in the person's brain stem, comprising:

an infusion catheter adapted for implantation on, in, or near the brain stem for  
15 neurological stimulation of target nerve tissue in the brain stem, the infusion catheter comprising a hollow tube adapted to be positioned on, in, or near the target nerve tissue in the brain stem and to deliver a chemical to the target nerve tissue in the brain stem; and

an infusion pump adapted for implantation in the person's body and operable  
20 to deliver the chemical through the infusion catheter to the target nerve tissue in the brain stem for chemical stimulation of the target nerve tissue in the brain stem.

35. The system of Claim 34, wherein the target nerve tissue in the brain stem is selected from a group consisting of nucleus solitarius, medulla oblongata,  
25 olivary nuclei, cerebellar tracts, inferior cerebellar peduncle, extrapyramidal system, trigeminal nucleus, nucleus gracilis, nucleus cuneatus, arcuate fibers, vagal nuclei, medial lemniscus, nucleus ambiguus, trigeminal nerves, spinothalamic tracts and vagus nerve.



36. The system of Claim 34, wherein the target nerve tissue in the brain stem affects the treatment of at least one condition selected from a group consisting of acute pain, chronic pain, headache, migraine headache, cluster headache, sinus headache, occipital headache, occipital neuralgia, trigeminal neuralgia, atypical facial  
5 pain, pseudotumor cerebri, nausea, depression, cardiac respiratory disorders, relex sympathetic dystrophy, causalgia, peripheral nerve pain, regional pain syndromes, ataxia, Parkinson's disease, movement disorders, tremors, akinesia, rigidity, dyskinesia, bladder dysfunction, detrusor dyssynergia, plexopathies, incontinence, interstitial cystitis, seizures, radiculopathy, diabetic neuropathy, Raynaud's disease,  
10 Raynaud's syndrome, Wegener's disease, cancer, sexual dysfunction, paraplegia, pelvic floor dysfunction, angina, obesity, anorexia and spasticity.

37. A method for neurological stimulation of target nerve tissue in a person's brain stem, comprising:  
15 implanting an infusion catheter on, in, or near the brain stem for chemical stimulation of target nerve tissue in the brain stem, the infusion catheter comprising a hollow tube adapted to be positioned on, in, or near the target nerve tissue in the brain stem, the infusion catheter operable to deliver a chemical to the target nerve tissue in the brain stem;  
20 implanting an infusion pump in the person's body, the infusion pump operable to deliver the chemical through the infusion catheter to the target nerve tissue in the brain stem; and  
using the infusion pump to deliver the chemical through the infusion catheter to the target nerve tissue in the brain stem for chemical stimulation of the target nerve  
25 tissue in the brain stem.

38. The method of Claim 37, wherein the target nerve tissue in the brain stem is selected from a group consisting of nucleus solitarius, medulla oblongata, olivary nuclei, cerebellar tracts, inferior cerebellar peduncle, extrapyramidal system,  
30 trigeminal nucleus, nucleus gracilis, nucleus cuneatus, arcuate fibers, vagal nuclei, medial lemniscus, nucleus ambiguus, trigeminal nerves, spinothalamic tracts and vagus nerve.

39. The method of Claim 37, wherein the target nerve tissue in the brain stem affects the treatment of at least one condition selected from a group consisting of acute pain, chronic pain, headache, migraine headache, cluster headache, sinus headache, occipital headache, occipital neuralgia, trigeminal neuralgia, atypical facial  
5 pain, pseudotumor cerebri, nausea, depression, cardiac respiratory disorders, relex sympathetic dystrophy, causalgia, peripheral nerve pain, regional pain syndromes, ataxia, Parkinson's disease, movement disorders, tremors, akinesia, rigidity, dyskinesia, bladder dysfunction, detrusor dyssynergia, plexopathies, incontinence, interstitial cystitis, seizures, radiculopathy, diabetic neuropathy, Raynaud's disease,  
10 Raynaud's syndrome, Wegener's disease, cancer, sexual dysfunction, paraplegia, pelvic floor dysfunction, angina, obesity, anorexia and spasticity.